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SELF-SYNCHRONIZED FIRES IN SUPPORT OF SHIP-TO-OBJECTIVE MANEUVER (STOM)

by:

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A paper is submitted to the Faculty of the Naval War College in partial satisfaction of the requirements of the Department of Joint Military Operations.

The contents of this paper reflect my own personal views and are not necessarily endorsed by the Naval War College or the Department of the Navy.

Signature: ______________________________

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Abstract of

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Self-synchronized joint fires in a netted environment are not able to provide the timely and accurate fire support required by infantry units when conducting Ship-to-Objective Maneuver (STOM) operations. The Naval Warfare Development Command conducted Fleet Battle Experiment India (FBE-I) to test whether the engagement of time-critical targets (TCT) could be significantly reduced by employing a flattened, more automated command and control structure with a digital fires network that could rapidly share targeting information in order to accelerate both tactical decision making and engagement of emergent targets. Under evaluation was the ability of the Navy's operational concept of Network-Centric Warfare (NCW) to aid in adequately satisfying the requirements of responsive and accurate fires delivered in support of the Marine Corps' operational concept of Ship-to-Objective Maneuver (STOM).

It was shown that netted fires could be used against targets that do not pose an immediate threat to friendly forces (battlefield preparation). The ability to self-synchronize fires to fulfill STOM requirements for TCT engagements has not been proven. Too many questions remain unanswered to determine the validity of rapid self-synchronized joint fires. Without timely and accurate long-range fire support, STOM will not be a viable operational concept for the Marine Corps.

Self-synchronized joint fires in a netted environment are not able to provide the timely and accurate fire support required by infantry units when conducting Ship-to-Objective Maneuver (STOM) operations. In June of 2001, the Naval Warfare Development Command conducted Fleet Battle Experiment India (FBE-I) in the operating areas off Southern California to test whether the time required to conduct Time-Critical Strike could be significantly reduced by employing a combination of a flattened, more automated command and control structure and a digital fires network that could rapidly share targeting information and accelerate both tactical decision making and engagement of emergent targets.[1] Under evaluation was the ability of the Navy's operational concept of Network-Centric Warfare (NCW) to aid in adequately satisfying the requirements of responsive and accurate fires delivered in support of the Marine Corps' operational concept of STOM. The data collected during FBE-I show that while it is possible for self-synchronized netted fires to be successfully employed against targets for preparation of the battlefield, they are not able to satisfy the time and accuracy requirements necessary to ensure the survival of infantry units conducting STOM operations.

INTRODUCTION

Changes in the international environment are producing military strategies that focus on operations in the littorals and require the rapid projection of power ashore. The United States must continue to possess the capability to conduct forcible entry operations into hostile areas from the sea, and over a larger and deeper battlefield than in the past. The Navy and Marine Corps are presently developing warfare doctrine to allow the United States to go anywhere U.S. interests may require.[2] Forces that are operating deep

inland "must be supported by direct and indirect fires with extended range, greater accuracy, and greater lethality."[3] The Navy's Network-Centric Warfare (NCW) and the Marine Corps' Operational Maneuver from the Sea (OMFTS) are concepts intended to fulfill these requirements by enabling forces to rapidly assault objectives ashore at higher speeds over longer distances with greater lethality of fires.

The Marine Corps' operational concept of STOM envisions operations launched from surface platforms at objectives hundreds of miles inland over hostile territory. Highly maneuverable forces will begin operations from widely dispersed platforms far over the horizon and project power farther and more rapidly than any other forces in the past.[4] These forces will require support from a limited number fire support assets tasked with multiple missions over the entire battlespace. These fire support systems "must provide fires with sufficient *responsiveness* and *accuracy* to support and facilitate successful maneuver or destroy enemy forces when required."[5]

But these operations require a unique operating environment that enhances the commander's situational awareness with respect to his own forces as well as the enemy's forces. Network-Centric Warfare (NCW) intends to produce this environment by enabling battlefield units to rapidly share information through an information network system which allows greater speed of command while giving them the ability to self-synchronize their actions to meet the commander's intent.[6]

SHIP-TO-OBJECTIVE MANEUVER (STOM)

In the past, amphibious operations were linear in nature, conducted in distinct phases from the initial presence of the force in the operating area, through the obtainment

of the final objective. Prior to any landing of forces, extensive preassault operations, consisting of naval and aerial shore bombardment or deception operations, were required to shape the battlefield for the assault. The next phase was the assault and seizure of a beachhead, followed rapidly by the buildup of combat power ashore. Once sufficient combat power was ashore, forces would then proceed toward their objective under an umbrella of protection from fire support systems ranging from organic artillery to naval gunfire to close air support.

The limited effective range of naval guns required fire support ships to be stationed only a few miles off the coast. The close proximity to the marines on the beach allowed for responsive fire support but range limitations made them unable to provide deep fire support once the marines left the beach. As the marines proceeded inland to their objective, they could only rely on organic artillery or close air support for protection.

The fire support organization for these operations was a vertical command structure with distinct lines of command and control from the shooter to the supported unit. When forces operated ashore, a fire support asset that was either in a direct support or general support role protected them.[7]

STOM changes that linear nature by using technological advances in mobility and command and control systems to replace the ponderous ship-to-shore movement that has characterized amphibious warfare for decades, thereby allowing forces to maneuver in tactical formations directly to their objectives from the moment they leave their launch platforms.[8] Assault forces will conduct operations into enemy territory without needing "to seize, defend, and build up beachheads or landing zones."[9]

During STOM, the traditional phases of amphibious operations will fade or disappear altogether. Forces will proceed from their attack positions at sea directly to their objectives without the need to halt and build up sufficient combat power at the beachhead. This requires an extensive command and control network predicated on timely and accurate intelligence detailing the enemy's intentions and dispositions. This network must provide the commander with real-time information regarding the status of friendly assets (i.e. location, ammunition inventory, current engagement status, etc.) in order for fire support systems to deliver accurate and responsive fires in support of these rapidly maneuvering forces. Launching forces from platforms over the horizon to objectives as far as 200 nautical miles inland exponentially expands the traditional amphibious operating area (AOA) and creates enormous challenges for command and control, intelligence, and fire support systems.[10]

While the challenges in all of these areas are great, perhaps the greatest challenge lies in the requirement to provide adequate fire support to units ashore when confronted by enemy forces. STOM requires air and surface fire support systems to be integrated into a network that must be capable of providing responsive, all-weather, long-range precision fires against critical targets "to surprise the enemy and create favorable conditions for employment of the landing force."[11]

Fire support systems must provide two levels of responsiveness based on the nature of the fires being delivered. Fires that will shape the battlefield prior to the arrival of maneuver forces are delivered against targets that do not pose an immediate threat to friendly forces, rather, they are designed to destroy or neutralize key enemy capabilities.[12] The time sensitivity for these targets is not as great as fires supporting

units ashore. Conversely, fires supporting forces ashore will be delivered against time-critical targets (TCT) and require a much higher level of responsiveness and accuracy. “The ability to rapidly process fire requests, quickly engage targets, and deliver and sustain a high volume of fire is critical.”[13]

Time-critical targets (TCT) are defined as targets that:

- Present an immediate significant threat (implies tremendous loss of life, or loss of high value assets) because of their capability, speed, location and/or range. These targets must be attacked when detected.

- Are identified as priority targets that offer only a short window of vulnerability (dwell time). These targets must be attacked and targeting data can change quickly.

- Become a priority due to their military significance during a particular phase of conflict or operation. (e.g. high payoff, lucrative targets that if struck immediately could alter the course of the conflict or targets that threaten the survival of key forces ashore.)[14]

The Marine Corps has quantified the “immediate” and “short window of vulnerability” terms from above by giving very specific time requirements for fire support. Current time requirements for TCT engagements were designed for infantry unit survivability and were developed for naval guns and artillery at targets less than 20 miles. The standard for naval gunfire support is ninety seconds from the time the fire mission is received until the ship is ready to fire.[15] For artillery, the standard is two and one half minutes from the time the call for fire is received to rounds on target.[16] “Time of flight is a critical issue when providing close supporting fires to maneuver forces in contact with the enemy” and the naval gunfire standard does not take into consideration the time of flight of the projectile.[17]

Extended range targets pose greater challenges with respect to time to engagement than ever before. Both of the previous standards were for shorter range

targets (less than 20 miles), but the requirements for new Naval Surface Fire Support (NSFS) systems are against targets at a range of 63 miles and must be as responsive as the specified times for artillery (2 ½ minutes).[18] An example of the difficulties this requirement presents is the Navy's Extended Range Guided Munition (ERGM). ERGM is designed to fire a high trajectory round to engage targets up to 63 miles, but has a time of flight of approximately eight minutes.[19] This falls well outside the 2 and ½ minute minimum for TCT engagement.

Proponents of network-centric warfare argue that distances will become less relevant in the Information Age.[20] They also contend that because information can travel almost instantaneously, it is irrelevant where "those who gather, analyze, make decisions, and possibly those who act on these decisions" are located.[21] This may be true for analysts and decision makers, but for those acting on those decisions, particularly units conducting time critical fire support, distance will always be a critical factor in the fire support equation.

NETWORK-CENTRIC WARFARE (NCW)

The battlespace of the 21st century will require commanders to have a keen awareness of the battlespace, be able to rapidly share accurate real-time information about friendly and hostile forces, and have the ability to employ widely dispersed forces to mass devastating effects upon the enemy.[22] Network-Centric Warfare (NCW) is intended to give the commander these abilities.

Three key fundamentals of NCW affect fire support operations – increased speed of command, shift of focus from platforms to networks, and the ability to mass effects

rather than massing forces.[23] Without the combination of all three factors, effective operational and tactical fires will not be possible and STOM will not become a viable warfighting doctrine.

Speed of command is "the time it takes to recognize and understand a situation (or change in the situation), identify and assess options, select an appropriate course of action, and translate it into actionable orders."[24] This is essential for STOM because the fire support assets will be dispersed throughout the vast battlespace and the ability to "see" and understand what is happening in real time should allow the commander to determine what assets will best support the forces ashore.

However, speed of command may be an inappropriate term. A more appropriate term may be command agility. The Joint Doctrine Encyclopedia defines agility as "the ability to move quickly and easily" and explains that agility should not be thought of in absolute terms but in relation to the enemy.[25] We want to be more agile than the enemy. The goal is not speed as defined by quantitative units, but timeliness and the ability to react faster than the enemy, thus reducing his options.[26]

Shifting the focus of operations from platforms to networks is intended to maintain situational awareness and increase the ability of the commander to make timely decisions (speed of command).[27] By knowing more rapidly what fire support the forces ashore need will not only enable weapons to be delivered earlier, but will also increase the likelihood that the appropriate weapons are chosen for a given target.

Focusing on networks instead of platforms is intended to not only increase the speed of command, but also increase the effects of the weapons delivered. A single weapon may be able to halt or destroy an enemy in the immediate area of that weapon for

a limited time, but the coordinated, rapid delivery of a combination of weapons at specific locations may create confusion for the enemy as to what he expects us to do and to what is actually occurring and could lead to related advantages throughout the battlespace over a longer period of time.[28] Effective delivery of weapons at critical locations may deny the enemy the ability to threaten friendly forces throughout the battlespace.

RESPONSIVENESS AND ACCURACY

For the infantry unit ashore, timeliness of fire support is critical for survival. An infantry unit confronted by enemy forces may only have minutes to defend itself or face annihilation. As long as time is the governing requirement, advanced, yet affordable, weapons that address the speed/distance portion of the equation must be considered. For example, using hypersonic (speed portion of the equation), loitering (distance portion), or space based (both variables) weapons may overcome this challenge.[29] Weapons like the Tactical Tomahawk Land Attack Missile (TTLAM) are designed to loiter over the battlespace and require only GPS coordinates to engage a TCT. It is also capable of in-flight retargeting and retasking if priorities dictate.[30] Unmanned Combat Air Vehicles (UCAV) loitering over the battlefield carrying air-to-surface guided munitions could also provide timely fire support to units deep inland.

Successfully engaging TCTs not only requires responsiveness, but also "accuracy" (the mean point of impact is close to the desired aimpoint) and "precision" (all rounds are close to the mean point of impact) which are determined to be a 20-meter circular error probability.[31] The guided munitions being designed for fire support all

require precise target location data in order to engage the target effectively.[32] If a sensor network does not provide the fire control quality data to the weapons, the full potential of our weapons arsenal cannot be utilized.[33] To obtain fire control quality data, target geo-refinement must be accomplished prior to weapon engagement. Geo-refinement could include tasking another sensor to look at the target or have the same sensor look at the target again in order to reduce the target location error (TLE). It could also include target mensuration, but in order to do mensuration, the area of operations must already have an established database from which to compute target location.[34] All of these additional actions that are needed to get fire control quality data add unwanted time to the already short engagement cycle.

Network-centric warfare flattens the fire support organization command structure by establishing an information network that includes, among other assets, maneuver units and fire support assets. It is intended to allow maneuver units and fire support assets to share real-time targeting information that should increase the responsiveness of fire support. The intent is to have all fire support assets supporting all units ashore simultaneously (a combination of direct and general support roles). Shared targeting information specifying what weapons should be needed to suppress certain targets and a comprehensive commander's guidance delineating fire support priorities should allow fire support units to self-synchronize and eliminate the need for a separate coordination center determining priority of fire support. These target priorities must be clear regarding TCT engagement criteria during all phases of an operation and the engagement decisions of all fire support assets must be immediately reflected in the common operating picture (COP) to prevent dual engagements and to allow for deconfliction between friendly

forces. Any confusion as to target priorities or an inaccurate COP will lead to delays in TCT engagements.

FLEET BATTLE EXPERIMENT INDIA (FBE-I)

In order for network-centric warfare and self-synchronization to work, warfighters must be connected to all forces within the battlespace and a COP must be established and maintained. This COP is intended to allow for rapid, integrated fires while still allowing the commander to override decisions at lower levels by "command by negation." The command and control organization created for FBE-I was developed to allow for self-synchronization of fire support at the lowest levels.

Command Cells. The Joint Operations Center (JOC) was the operational level cell for preplanned targets and focused on preplanned "now" targets and the planning of future targets. It was responsible for ensuring that the Joint Force Commander's (JFC) targeting priorities were met throughout the operating area.[35]

The Joint Fires Element (JFE) focused on the delivery of tactical level fires within the area where STOM operations were taking place. This area can be a Littoral Penetration Area (LPA) or subdivided into Littoral Penetration Zones (LPZ). The JFE is responsible for the execution of fires against TCTs within these areas. It also resolves disputes over the shared use of tactical resources by the execution cells and aids in cell self-synchronization. If multiple LPAs are established, each one will have an associated JFE, with the JOC resolving any disputes between JFEs.[36]

Execution Cells. The Experimental Combat Operations Center (ECOC) was the primary execution center for Marine forces ashore conducting STOM operations. The

ECOC linked forces ashore with joint fire support assets. The ECOC received all calls for fire and promulgated them throughout the network for servicing by fire support forces while exercising overall coordination of supporting fires. Only the ECOC could authorize the delivery of fires within the LPA/LPZ. This included fires ranging from artillery and squad weapons to full Joint Fires.[37]

Two other execution cells were tasked with the air delivered fire support. They are the Joint Air Operations Center (JAOC) and the Tactical Air Control Center (TACC).

The JAOC was the Joint Force Air Component Commander's (JFACC) execution cell for joint fires. Their task was the deconfliction and coordination of TACAIR missions outside ECOC's and Joint Force Maritime Component Commander's (JFMCC) areas of responsibility while monitoring the execution of preplanned missions and coordinating TACAIR response to TCTs.[38]

The TACC was the primary air control agency within the LPA from which all air operations supporting the forces in that LPA were controlled. The TACC controlled air support assets including fighter and attack aircraft, surface-to-air missiles (SAMs), and antiaircraft artillery (AAA).[39]

Figure 1 shows the command relationship for joint fires and shows how the cells tasked with executing fire support missions (ECOC, JAOC, CVIC, TACC) were networked with the cells tasked with planning and monitoring fire support missions (JOC, JFE).[40]

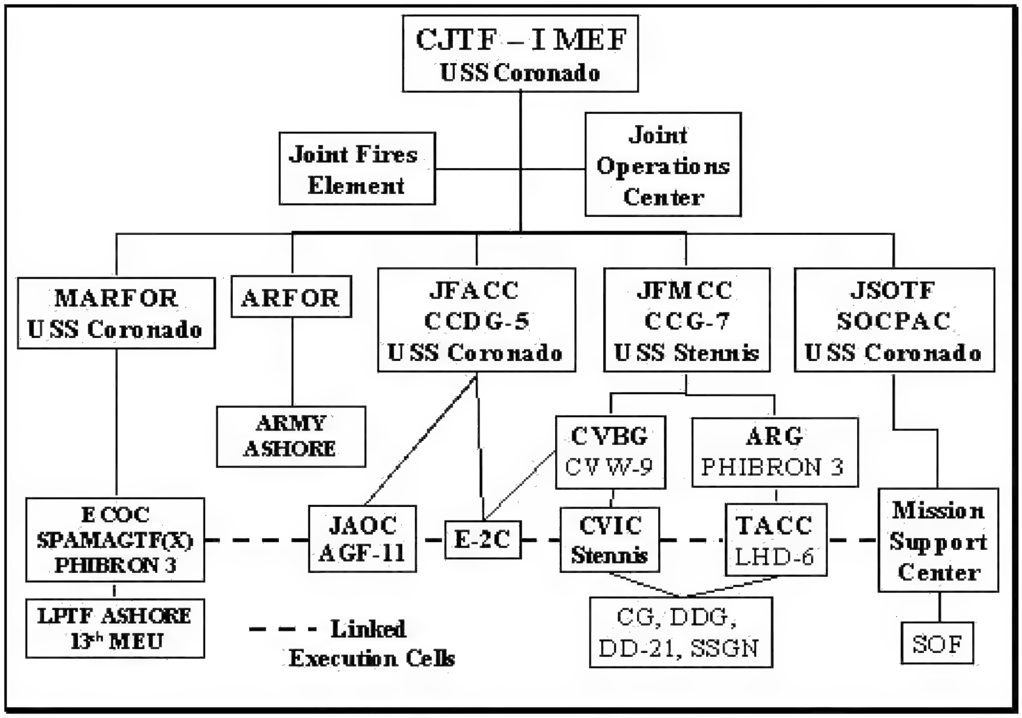

FIGURE 1. - COMMAND RELATIONSHIPS DIAGRAM FOR FBE-I

In order for self-synchronization to occur among the execution cells, three key elements must be present: the cells must be "robustly" networked together, share a common situational awareness, and have guidance from the commander regarding TCT priorities.[41] In this sense, robust would mean durability and vulnerability. The network must be able to sustain operations over an extended period of time (weeks or even months) because any interruption in connectivity would mean disaster for troops on the ground. The network would also have to be impervious to attack from enemy information warfare capabilities that attempt to disrupt the network.

We have already shown the netted environment with all execution cells sharing a COP. The final element that is needed for self-synchronization is a detailed commander's intent specifying the engagement priorities of TCTs.

Time-critical targets may be tactical, operational, or even strategic in nature.[42] The commander's guidance for engagement must specify which targets are most important during each phase of the operation (prior to forces landing, as forces proceed ashore, and as forces are engaged ashore). A unit suddenly confronted by enemy forces may not have as high a strategic or operational priority as the destruction of a mobile missile launcher that is in position to launch against the main force. However, in a different phase of the operation, the survival of that unit may have the highest strategic priority among all targets. When determining TCT priorities, commanders "must evaluate trade-offs associated with striking or not striking TCTs in certain circumstances" and understand the risks associated with these trade-offs.[43] Appendix A shows the target priorities for Phase IV of operations for FBE-I where the focus of effort was the support of the MEB STOM.[44] The fires for this phase were focused on enemy reinforcing units and potential counterattack formations to ensure survival of friendly forces ashore.

With all fire support assets being able to engage targets throughout the operating area, battlespace deconfliction measures must be established to prevent duplication of fires or fires upon friendly forces. For FBE-I, as the maneuver forces advanced, the rear boundary of the LPZ was "rolled up", acting similarly to a Fire Support Coordination Line (FSCL), and control of this area was relinquished by the ECOC. Targets within this area could now be engaged without coordination with ECOC, provided no adverse effects were produced within the LPZ. Firing of special ammunition such as smoke and illumination must have been coordinated between execution cells to prevent unwanted effects within the LPZ.[45] The ECOC conducted airspace deconfliction in the LPZ, however, in areas outside the LPA, the JAOC retained the responsibility for airspace

deconfliction. In cases where the weapon flight path passed through the airspace of an LPZ, coordination with the ECOC was required.[46] Coordination between cells must be almost instantaneous in order to meet TCT engagement requirements. Any delays in cell coordination are only compounded as engagement orders are issued. Because this is not the doctrinal procedure for conducting fire support deconfliction, time delays could be expected until execution cells become more familiar with the procedures.

SELF-SYNCHONIZED JOINT FIRES

If you were to examine only the empirical data collected from FBE-I regarding the time required to provide fire support against TCTs, the only conclusion that can be reached is that self-synchronization of fires does not meet the time requirements of STOM forces ashore. Appendix B shows that only 57 percent of the targets considered time-critical (dwell time less than 30 minutes) were engaged during FBE-I. Even if five minutes constituted an "immediate" response for TCTs (twice the 2 ½ minute requirement for Naval Surface Fire Support systems), zero targets were engaged. A 30 minute dwell time was chosen because that is the time it takes a well-trained transporter-erector-launcher (TEL) crew to conduct a launch.[47] An infantry unit may need fire support within minutes of contact with the enemy and the failure to deliver this fire rapidly detracts from the ability of the Joint Force Commander to ensure the survivability of forces ashore.

However, final judgement on the ability of units to self-synchronize cannot be passed without further examination as to why engagement times took so long. Two causes for the delays could be attributed to; 1) the length of time the execution cells

required to conduct deconfliction among cells and; 2) the time required to issue the command to fire (Appendices C and D).

Investigation into the excessive times determined that operational issues were the cause of some of the delays. Of particular note was the lack of watchstander knowledge as to the requirements of the various weapons used for fire support. Operators of the Land Attack Warfare System (LAWS) "often either did not recognize, or understand the significance of, the low CE/LE [circular error/linear error] values in the [target] nomination" because they requested geo-refinement on targets that had already been mensurated.[48] Also, fifty-four percent of the targets that required mensuration were fired unmensurated because operators "didn't think mensuration was required, [or] mistakenly believed the target was mensurated when it was not and gave up waiting for mensuration."[49]

Self-synchronization requires a detailed commander's intent so units are fully aware of the target priorities during a particular phase of operations. Appendix A shows a fairly complex matrix for priority of fires. It was not noted if delays were encountered because there was conflicting interpretations of commander's intent between cells or if there was just confusion in interpreting the matrix.

The other question is why so much time was required for the issuance of the command to fire (Appendix D)? It is not known, but one of the causes could be a concern over collateral damage in the vicinity of the target. Recent experiences in Kosovo and Afghanistan have shown that commanders at all levels are very attuned to what collateral damage may occur if a target is engaged. Self-synchronization requires units at the lowest levels to respond automatically to calls for fire once the target location

is known. With the commander's ability to monitor all activities within the battlespace, what prevents him from delaying all firing orders until the resultant collateral damage can be evaluated? And at what level is this evaluation made? If collateral damage evaluation is needed, how long does it take, and does it defeat the purpose of self-synchronization? There is no discussion of this during FBE-I, so it is unknown if this delayed TCT engagements, but this is a realistic concern that must be addressed.

Along the same lines as collateral damage is the issue of the law of war. Are the targets being engaged legal targets in accordance with the Law of Armed Conflict? The infantry unit on the ground threatened by enemy forces is not concerned with the legality of the target; he is concerned with survival and the immediate destruction of the enemy forces threatening him. If execution cells have to consult a higher authority (or even a legal authority within their cell) to determine target legality (19 nations needed to approve targets in Kosovo), self-synchronization is not occurring and other procedures need to be developed to deliver timely fire support.

CONCLUSION

While FBE-I was a good starting point, there are still many things we need to know in order to determine if self-synchronized fires will satisfy all the fire support requirements of STOM. In future experiments, an opposing force (Red Cell) whose objective was to use information warfare to infiltrate and disrupt the information network could be used to test the durability and vulnerability of the information network. Once the survivability of the network has been proven (and it must be proven in order for NCW to work), the ability of units to self-synchronize can then be evaluated.

Unlike FBE-I, where participating units were also preparing to deploy shortly after the completion of the experiment, dedicated FBE forces that are familiar with equipment operation and have an understanding of the new procedures (proposed doctrine changes) need to be stood up for future experiments. This will establish a control group that reduces operator errors and allows the ability of the network and self-synchronization to be evaluated instead of the operators. By formalizing advanced systems training for the operators, along with coordinated training with the execution and control cells, enhanced understanding of system capabilities, limitations, and requirements would result. TCT engagement data could then be reevaluated to determine if engagement times meet the requirements of STOM.

STOM relies on highly maneuverable assault forces that are intended to exploit enemy vulnerabilities in order to obtain their objective and requires a fire support network capable of delivering fires that will unbalance and defeat an adversary by rapidly integrating fires from widely dispersed platforms. "Achieving rapid, integrated fire will require a fully netted digital fires network capable of combining sensors, command and control and fires into a networked system that enables rapid self-synchronization and decisive actions."[50]

While netted fires can be used against targets that do not pose an immediate threat to friendly forces (i.e. fires that shape the battlefield) the ability of units to self-synchronize and deliver fires rapidly to fulfill STOM requirements for TCT engagements has not been proven. Too many questions still remain unanswered before the validity of rapid self-synchronized joint fires can be determined. Without timely and accurate long range fire support, STOM will not be a viable operational concept for the Marine Corps.

High Payoff Target List/Attack Guidance M
Target Selection Standards – Phase

PRI 1 2 3 4 5 6

ATTACK SYSTEMS

Enemy Asset	ARMOR M-60A1 Chieftain T-72 BMP-1,2	INDIR FIRE D-30 BM-21 M-46 Type 63 M-109A1,115 GHN-45	ADA SYSTEMS Vanguard FM-80 ZSU 57-2 HAWK ZSU-23-4 SA-6,10,11,15,19	C2 SITES M577	CMBT A/C F-4,5,14 AH-1J MiG-21,23,25,29 Su-22,24,25 Mirage F-1	CDCM CSSC-3 C801 C802	PATRO BOAT Mk III Boghamma Kaman
NSFS	1 A 2 Co 3 Stationary 4 <45 min **S 5**	1 I 2 Battery 3 Stationary 4 <45 min **N 3**	1 A 2 1 vehicle 3 Stationary 4 <45 min **N 4**	1 A 2 Bn 3 Stationary 4 <45 min **S 1**	1 A 2 1 Aircraft 3 Stationary 4 <45 min **S 3**	1 I 2 1 vehicle 3 Stationary 4 <45 min **N 2**	1 A 2 1 Vessel 3 Stat/Move 4 <45 min **N**
TLAM	1 A 2 Co 3 Stationary 4 <45 min **S 5**	1 I 2 Battery 3 Stationary 4 <45 min **N 3**	1 A 2 1 vehicle 3 Stationary 4 <45 min **N 4**	1 A 2 Bn 3 Stationary 4 <45 min **S 1**	1 A 2 1 Aircraft 3 Stationary 4 <45 min **S 4**	1 I 2 1 vehicle 3 Stationary 4 <45 min **N 2**	1 A 2 1 Vessel 3 Stationary 4 <45 min **N**
IO	**Beyond scope of conventional targeting process**						
ARTY	1 A 2 Co 3 Stationary 4 <45 min **S 5**	1 A 2 Battery 3 Stationary 4 <45 min **N 4**	1 A 2 1 vehicle 3 Stationary 4 <45 min **N 1**	1 I 2 Bn 3 Stationary 4 <45 min **N 2**	1 A 2 1 Aircraft 3 Stationary 4 <45 min **S 3**	1 I 2 1 vehicle 3 Stationary 4 <45 min **N 3**	1 A 2 1 Vessel 3 Stationary 4 <45 min **S**
FW	1 A 2 Co 3 Stat/move 4 <1 Hr **N 1**	1 A 2 Battery 3 Stationary 4 <1 Hr **N 3**	1 A 2 2 vehicles 3 Stat/move 4 <1 Hr **EW 6**	1 A 2 Bn 3 Stationary 4 <1 Hr **N 4**	1 A 2 1 Aircraft 3 Stat/move 4 <1 Hr **N 1**	1 I 2 1 vehicle 3 Stat/move 4 <1 Hr **N 2**	1 A 2 1 Vessel 3 Stat/move 4 <1 Hr **N**
RW	1 A 2 Co 3 Stat/move 4 <1 Hr **D 1**	1 A 2 Battery 3 Stat/move 4 <1 Hr **N 3**	1 A 2 2 vehicles 3 Stat/move 4 < 1 Hr **S 6**	1 A 2 Bn 3 Stationary 4 <1 Hr **N 4**	1 A 2 1 Aircraft 3 Stat/move 4 <1 Hr **D 3**	1 I 2 1 vehicle 3 Stat/move 4 <1 Hr **N 2**	1 A 2 1 Vessel 3 Stat/move 4 <1 Hr **D**

TARGET SELECTION STANDARDS
1. **WHEN TO ATTACK (I=IMMEDIATE, A=AS ACQUIRED, P=INCLUDE IN PRGM OF FIRES)**
2. **MINIMUM TARGET SIZE**
3. **ACTIVITY IN ORDER TO ENGAGE**
4. **MINIMUM TIME ACQUIRED**

PRIORITY OF ATTACK 1-6

D=D
N=NEUTRA
S=SU
EW=

Appendix B

ENGAGEMENTS THAT WERE FIRED AND THOSE THAT MET NLT TIME AS A FUNCTION OF TARGET DWELL TIME[51]

	SURFACE FIRES		TACAIR	
DWELL TIME (hr.)	# FIRED	# MET NLT	# FIRED	# MET NLT
0.17	1		1	
0.33	1	1		
0.5	1	1	3	2
1	4	2	11	7
1.5	8	5	3	2
2.5			1	
3	4	4	4	4
4	1	1	1	1
6	2	2	5	5
18	1	1		
24	5	5	5	5
TOTALS	28	22	34	26
% THAT MET NLT		78.6		76.5

Appendix C

TIME INTERVALS FOR COORDINATION BLOCK [52]

COORDINATION BLOCK	MEAN (MINUTES)	MEDIAN	STANDARD DEVIATION	SAMPLE SIZE
ECOC	53.6	33.9	58.5	95
JAOC	53.7	26.6	72.5	213
JFMCC	69.3	41.5	71.0	154
JFE	64.1	21.1	89.6	47

Appendix D

TIME REQUIRED TO ISSUE THE FIRE COMMAND [53]

MEAN (MINUTES)	MEDIAN	STANDARD DEVIATION	SAMPLE SIZE
85.6	45.5	94	100

ENDNOTES

1. Naval Warfare Development Command, Fleet Battle Experiment India, conducted 18-28 June 2001. <http://mbc.nwdc.navy.smil.mil/fbe/files/FBE-India ExPlan v.3.a Full.doc> (14 December 2001), Section 2.5.1.1.
2. Chairman of the Joint Chiefs of Staff, National Military Strategy of the United States of America Shape, Respond, Prepare Now: A Military Strategy for a New Era (Washington, D.C.: 1997), p. 26.
3. Concept and Employment Working Group. "Concept of Employment for Naval Surface Fire Support (Near Term Capability)." <http://www.fas.org/man/dod-101/sys/ship/weaps/docs/C1031.htm> (27 November 2001), p. 3.
4. U.S. Marine Corps, Marine Corps Concept Paper: Ship-to-Objective Maneuver (MCCP: Ship to Objective Maneuver) Washington, D.C.: July 25, 1997, p. 6.
5. U.S. Marine Corps, Marine Corps Concept Paper: Advanced Expeditionary Fire Support (MCCP: Advanced Expeditionary Fire Support) Washington, D.C.: January 20, 1998, p. 8.
6. Arthur K. Cebrowski, "Network-Centric Warfare: Its Origin and Future." U.S. Naval Institute Proceedings, January 1998, p. 32.
7. Supporting Arms in Amphibious Operations (NWP 3.09-11M) Washington, D.C., March 1995, p. 2-14. In a direct support role, the fire support asset communicates directly to the unit and provides fire support as required. This means that the fire support asset is not available to provide fire support to other units. In a general support role the fire support asset communicates with a coordination center that directs fires as needed among several units. The coordination center determines the priority of the target, the appropriate type of weapon needed to suppress the target (naval gunfire, air, or artillery) and then assigns the fire support asset accordingly. In this case, one fire support asset can support several units simultaneously.
8. U.S. Marine Corps, Marine Corps Concept Paper: Ship-to-Objective Maneuver (MCCP: Ship to Objective Maneuver) Washington, D.C.: July 25, 1997, p. 4.
9. Ibid., p. 7.
10. Naval Warfare Development Command, Fleet Battle Experiment India, conducted 18-28 June 2001. <http://mbc.nwdc.navy.smil.mil/fbe/files/FBE-India ExPlan v.3.a Full.doc> (14 December 2001), Section 2.5.1.3.1.1.1.
11. U.S. Marine Corps, Marine Corps Concept Paper: Advanced Expeditionary Fire Support (MCCP: Advanced Expeditionary Fire Support) Washington, D.C.: January 20, 1998, p. 3-4.
12. Ibid., p. 4.
13. Ibid., p. 8.
14. Time-Critical Strike Concept of Operations (Draft). Washington, D.C.: ND, p. 3.
15. Amphibious Warfare Exercises (FXP 5 Rev B) Washington, D.C.: July 1997, AMW-2-SF FIREX II.
16. Commanding General, Marine Corps Combat Development Center to Chief of Naval Operations (N85 and 86), 03 December 1996, <http:www.usnfsa.com/articles/usmc/usmc1htm>, "Subj: Naval Surface Fire Support for Operational Maneuver from the Sea," p. 8.
17. Ibid., p. 8.
18. Ibid., p. 1-4.
19. Concept and Employment Working Group. "Concept of Employment for Naval Surface Fire Support (Near Term Capability)." <http://www.fas.org/man/dod-101/sys/ship/weaps/docs/C1031.htm> (27 November 2001), p. 10.
20. David Alberts and others, Network Centric Warfare: Developing and Leveraging Information Superiority. 2nd ed. (Revised), CCRP Publications, August 1999, p. 19.
21. Ibid., p. 19.
22. Chairman of the Joint Chiefs of Staff, National Military Strategy of the United States of America Shape, Respond, Prepare Now: A Military Strategy for a New Era (Washington, D.C.: 1997), p. 18.
23. Arthur K. Cebrowski, "Network-Centric Warfare: Its Origin and Future." U.S. Naval Institute Proceedings, January 1998, p. 31-32.
24. David Alberts and others, Network Centric Warfare: Developing and Leveraging Information Superiority. 2nd ed. (Revised), CCRP Publications, August 1999, p. 154.
25. Joint Doctrine Encyclopedia. Washington, D.C.: July 16, 1997, p. 12.
26. Ibid., p. 12.

27. Arthur K. Cebrowski, "Network-Centric Warfare: Its Origin and Future." U.S. Naval Institute Proceedings, January 1998, p. 33.
28. Joint Doctrine Encyclopedia. Washington, D.C.: July 16, 1997, p. 13.
29. Naval Warfare Development Command, "Future Naval Fires Concept Paper (Draft)," December 2001, p. 4.
30. Naval Warfare Development Command, Fleet Battle Experiment India, conducted 18-28 June 2001. <http://mbc.nwdc.navy.smil.mil/fbe/files/FBE-India ExPlan v.3.a Full.doc> (14 December 2001), Section 2.5.1.2.1.13-.19.
31. Concept and Employment Working Group. "Concept of Employment for Naval Surface Fire Support (Near Term Capability)." <http://www.fas.org/man/dod-101/sys/ship/weaps/docs/C1031.htm> (27 November 2001), p. 5.
32. ERGM, TTLAM, Land Attack Standard Missile (LASM), AGM-65 Maverick, AGM-88 High-Speed Anti-Radiation Missile (HARM), Joint Direct Attack Munitions (JDAM) GBU-29/30/31/32, and AGM-154A Joint Stand-Off Weapon (JSOW) all require accurate GPS coordinates to engage targets.
33. Naval Warfare Development Command, "Future Naval Fires Concept Paper (Draft)," December 2001, p. 9.
34. Target mensuration is the process of using a registered terrain database and three points in the image of the target to map to the terrain. In many of the areas that we operate we do not have established terrain databases.
35. Naval Warfare Development Command, Fleet Battle Experiment India, conducted 18-28 June 2001. <http://mbc.nwdc.navy.smil.mil/fbe/files/FBE-India ExPlan v.3.a Full.doc> (14 December 2001), Section 2.5.2.2.
36. Ibid., Section 2.5.2.3.
37. Ibid., Section 2.5.1.4.1.3.
38. Ibid., Section 2.5.2.5.
39. Ibid., Section 2.5.2.6.
40. Ibid., Section 2.5.2.1.
41. David Alberts and others, Network Centric Warfare: Developing and Leveraging Information Superiority. 2nd ed. (Revised), CCRP Publications, August 1999, p. 166.
42. Time-Critical Strike Concept of Operations (Draft). Washington, D.C.: ND, p. 4.
43. Naval Warfare Development Command, Fleet Battle Experiment India, conducted 18-28 June 2001. <http://mbc.nwdc.navy.smil.mil/fbe/files/FBE-India ExPlan v.3.a Full.doc> (14 December 2001), TTP in Support of Joint Fires for FBE-I, p. 19.
44. A MEB is a Marine Expeditionary Brigade consisting of approximately 15,000 troops.
45. Naval Warfare Development Command, Fleet Battle Experiment India, conducted 18-28 June 2001. <http://mbc.nwdc.navy.smil.mil/fbe/files/FBE-India ExPlan v.3.a Full.doc> (14 December 2001), Section 2.5.1.3.1.1.1.
46. Ibid., Section 2.5.1.4.1.3.
47. Ibid., Section 2.5.1.3.1.2.
48. Ibid., Appendix 1 Section E. LAWS terminals are located in all command and execution cells and are used to input target location, conduct deconfliction among cells, make target-weapon pairing selection, and issue firing commands to units.
49. Ibid., Appendix 1 Section E.
50. Naval Warfare Development Command, "Future Naval Fires Concept Paper (Draft)," December 2001, p. 2.
51. Naval Warfare Development Command, Fleet Battle Experiment India, conducted 18-28 June 2001. <http://mbc.nwdc.navy.smil.mil/fbe/files/FBE-India ExPlan v.3.a Full.doc> (14 December 2001), Appendix 1 Table 10 Section A.5.
52. Ibid., Appendix 1 Table 5 Section A.3b.
53. Ibid., Appendix 1 Table 6 Section A.3b.

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